Foundations of Modern Networking

SDN, NFV, QoE, IoT, and Cloud

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Chapter 5

SDN Control Plane

•Cache Constraint

- Requires that the data within a response to a request be implicitly or explicitly labeled as cacheable or non-cacheable
- If a response is cacheable, then a client cache is given the right to reuse that response data for later, equivalent requests
- Therefore, subsequent requests for the same data can be handled locally at the client, reducing communication overhead between client and server

Uniform Interface Constraint

- REST emphasizes a uniform interface between components, regardless of the specific client-server application API implemented using REST
- To obtain a uniform interface, REST defines four interface constraints:
  - Identification of resources
  - Manipulation of resources through representations
  - Self-descriptive messages
  - Hypermedia as the engine of the application state
- The benefit of this constraint, for an SDN environment is that different applications can invoke the same controller service via a REST API

• Layered System Constraint

- A given function is organized in layers, with each layer only having direct interaction with the layers immediately above and below
- This is a fairly standard architecture approach for protocol architectures, OS design, and system services design

• Code-on-Demand Constraint

- REST allows client functionality to be extended by downloading and executing code in the form of applets or scripts
- This simplifies clients by reducing the number of features required to be pre-implemented
- Allowing features to be downloaded after deployment improves system extensibility

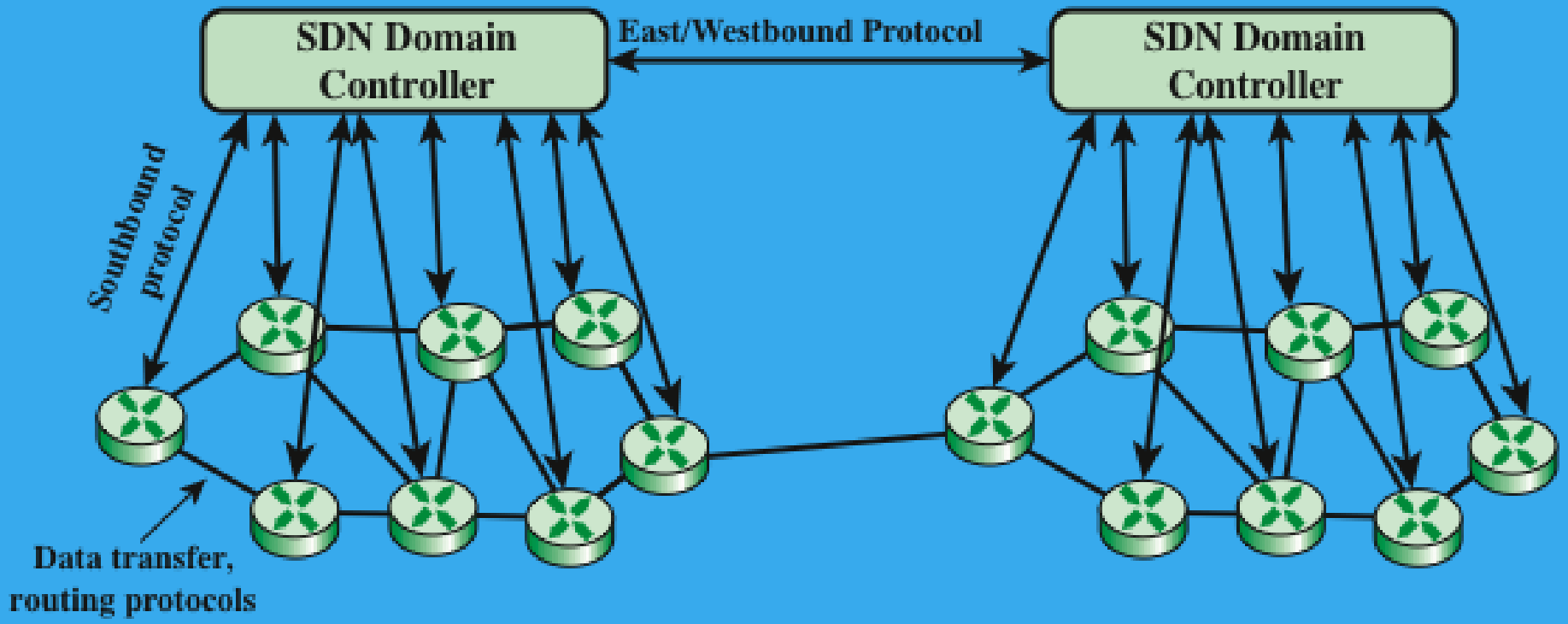

Figure 5.10 SDN Domain Structure

High-Availability Clusters

- The primary node is responsible for answering all traffic that is sent to the cluster's external IP address and holds a read/write copy of the configuration data
- The second node operates as a standby, with a read-only copy of the configuration data, which is kept current with the primary's copy
- The secondary node monitors the state of the external IP
- If the secondary node determines that the primary node is no longer answering the external IP, it triggers a failover, changing its mode to that of primary node
- It assumes the responsibility for answering the external IP and changes its copy of configuration data to be read/write
- If the old primary reestablishes connectivity, there is an automatic recovery process trigger to convert the old primary to secondary status so that configuration changes that are made during the failover period are not lost

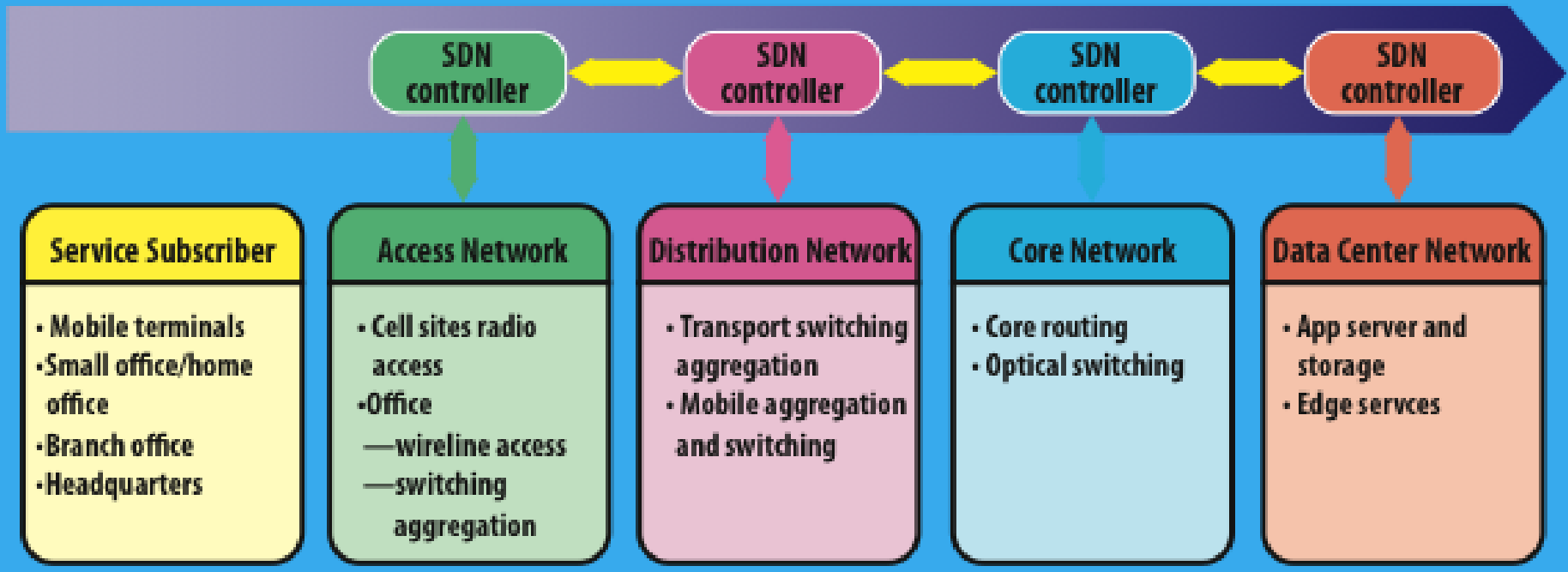

Figure 5.11 Federation of SDN Controllers

Border Gateway Protocol (BGP)

- Was developed for use in conjunction with internets that use the TCP/IP suite
- Has become the preferred exterior router protocol (ERP) for the Internet
- Enables routers, called gateways in the standard, in different autonomous systems to cooperate in the exchange or routing information
- The protocol operates in terms of messages, which are sent over TCP connections
- The current version of BGP is BGP-4

BGP

- Three functional procedures are involved in BGP:

Neighbor acquisition

The term *neighbor* refers to two routers that share the same network

Occurs when two neighboring routers in different autonomous systems agree to exchange routing information regularly

Neighbor reachability

Once a neighbor relationship is established this procedure is used to maintain the relationship

Each partner needs to be assured that the other partner still exists and is still engaged in the neighbor relationship

Network reachability

Each router maintains a database of the networks that it can reach and the preferred route for reaching each network

Whenever a change is made to this database, the router issues an Update message that is broadcast to all other routers for which it has a neighbor relationship

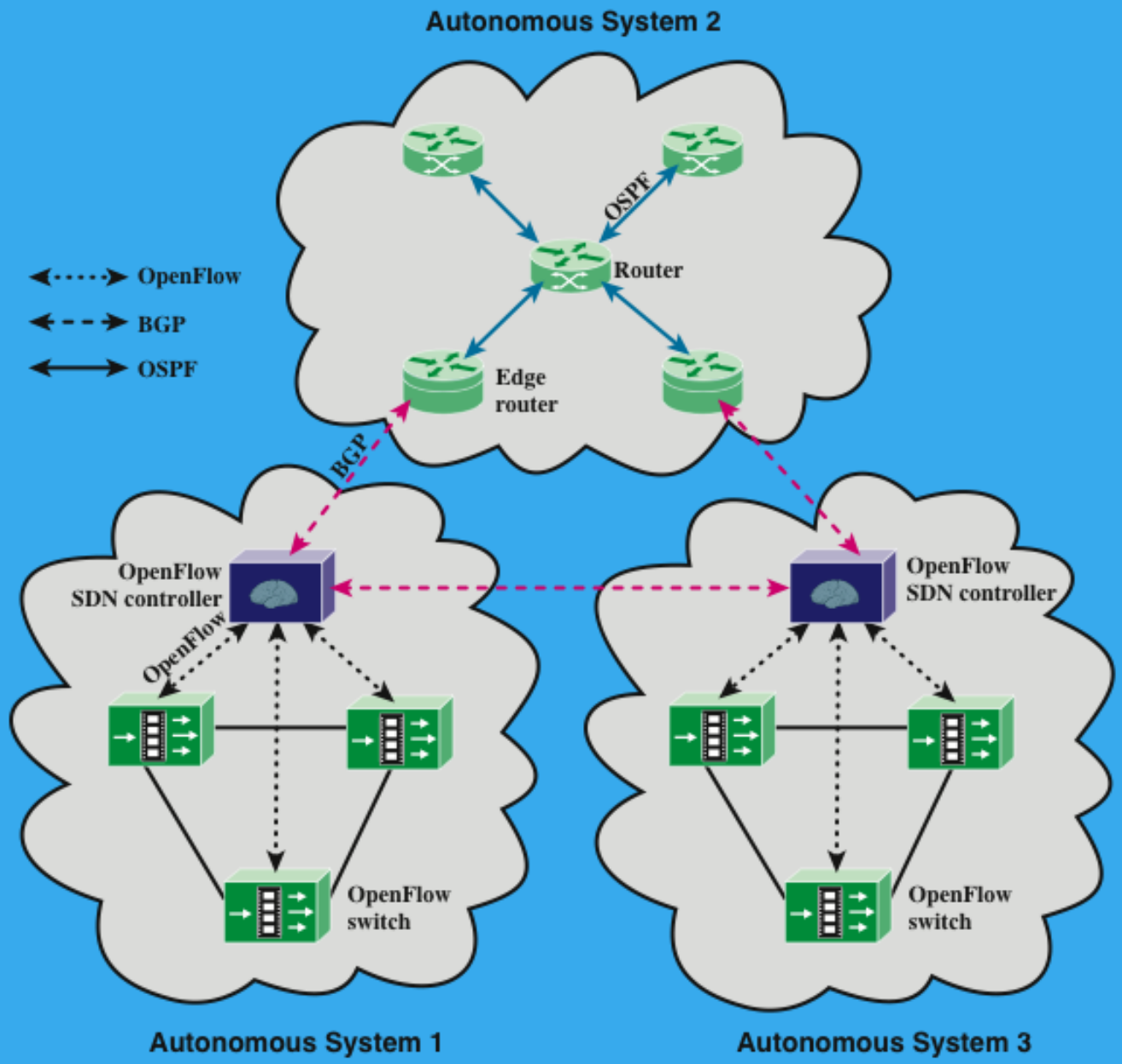

Figure 5.12 Heterogeneous Autonomous Systems with OpenFlow and non-OpenFlow Domains

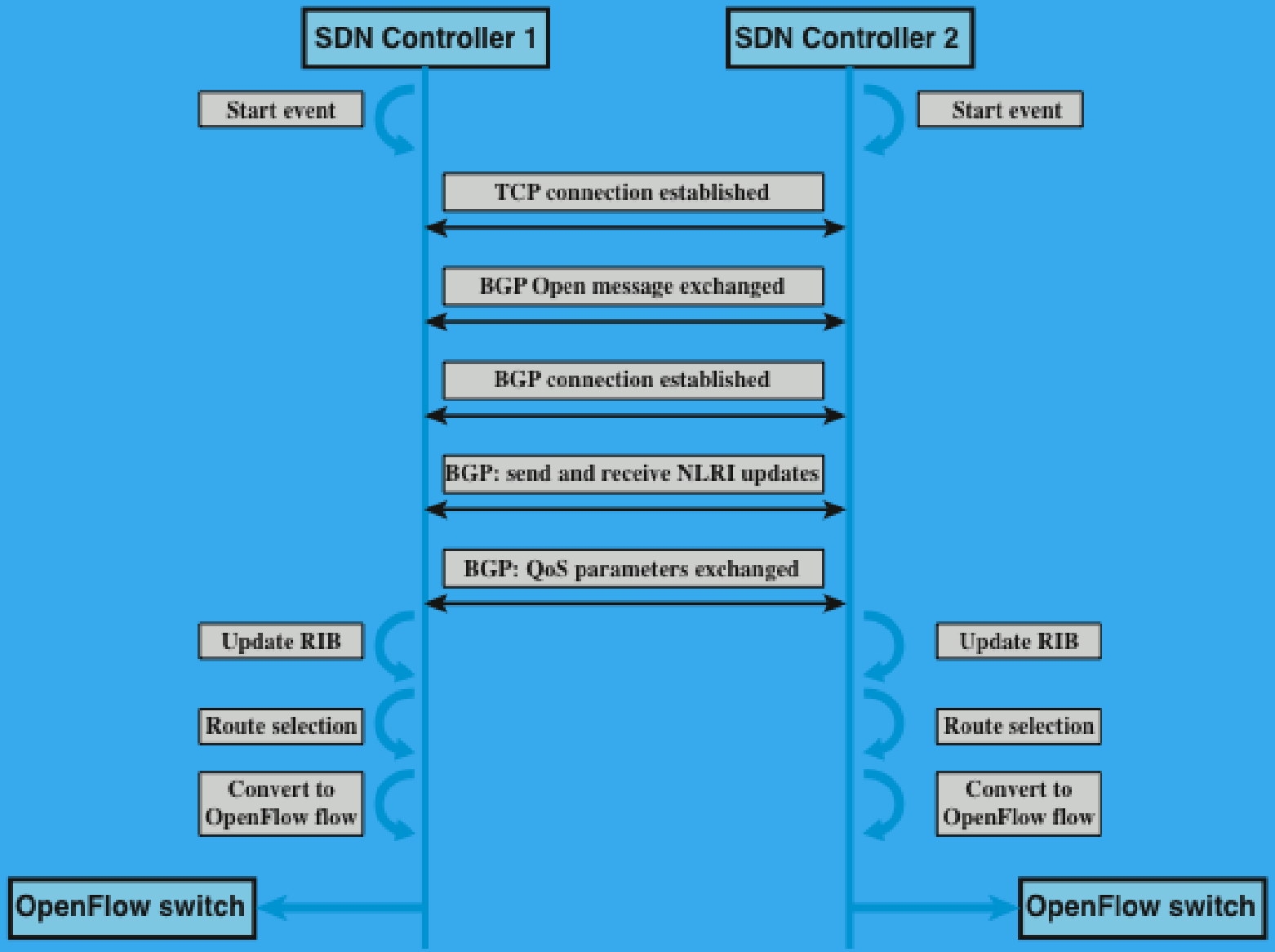

Figure 5.13 East-West Connection Establishment, Route, and Flow Setup

IETF SDNi

- A draft specification that defines common requirements to coordinate flow setup and exchange reachability information across multiple domains
- SDNi functionality includes:
  - Coordinate flow setup originated by application, containing information such as path requirement, QoS, and service level agreements across multiple SDN domains
  - Exchange reachability information to facilitate inter-SDN routing; this will allow a single flow to traverse multiple SDNs and have each controller select the most appropriate path when multiple such paths are available

End of Chapter 5